Field: Chemistry

Project Title: The Synthesis and Characterization of Novel Photocages for Efficient Photorelease

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Abstract

Photocages are a specific class of organic compounds developed to meet the growing need for precise molecular release. Their structure allows for the absorption of light at specific wavelengths, triggering the release of an attached substituent at highly defined times and locations. The ultimate goal of this research is to employ these photocages in the field of drug delivery as carriers of biologically active compounds. However, due to the novelty of the field and the structural specificity of such compounds, the current scope and characterization of organic scaffolds that can potentially be used as photocages are limited. To address this gap, this project aims to synthesize and characterize a novel library of fluorene-based photocage scaffolds to optimize efficient photorelease by systematically tuning their chemical properties.

This project explores the structural versatility of the fluorene core via a multi-step organic synthesis starting from a fluorene precursor, leading to the formation of a stable carbocation intermediate that can be used to rapidly generate a library of photocaged substituents. Reaction progress, purity, and photorelease efficiency are evaluated using a suite of analytical techniques, including TLC chromatography, GC-MS spectrometry, NMR spectroscopy, and UV-Vis spectroscopy to calculate quantum yield. Current focus involves optimizing the reaction pathway leading to the carbocation intermediate and establishing stocks of intermediates for further stages of the work. Beyond drug delivery, these tools promise to support advancements in kinetic studies, material science, and neurobiology by providing unprecedented spatial and temporal resolution to track complex biological processes such as brain activity, ultimately offering non-invasive control over diverse molecular systems.